



Elementary Geometry Session 2

Topic	Activity Name	Page Number	Related SOL	Activity Sheets	Materials
Classification	Tibble	36	1.20		
	What's In the Box?	37	K.11, K.12, K.13, K.17, 1.20		Attribute blocks
	Missing Pieces	38	K.17, 1.20		Attribute blocks
	What's My Rule?	39	K.17, 1.20	What's My Rule?	Attribute blocks
	Twenty Questions Game	41	K.17, 1.20		Attribute blocks
	Who Am I? Game	42	K.17, 1.20	Clue Cards	Attribute blocks
	Differences – Trains and Games	50	K.17, 1.20	Differences Game Mat	Attribute blocks, game mat
	Hidden Number Patterns	53	K.17, 1.20	Hidden Number Sheets 1 and 2	Attribute blocks
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Identifying Figures	Human Circle	59	K.11, K.12, 1.16, 1.17, 2.20, 2.22, 3.18, 4.17		String
	Geoboard Triangles and Quadrilaterals	60	K.11, K.12, 1.16, 1.17, 2.20, 2.22, 3.18	Geoboard Dot Paper	Geoboards, rubber bands, geoboard dot paper
	Figure Hunt	62	1.17		Electronic camera, computer, drawing software or Polaroid cameras and film; magic markers; poster board; and paste

**Topic:** Classification Using Attribute Materials

Description: Participants will explore the concept of classifying; a basic process of mathematical thinking that is essential to many concepts that are developed in the grades K-5 mathematics curriculum. Classification involves the understanding of relationships. Classification activities (observing likenesses and differences) can be presented through problem-solving situations and provide students with the opportunity to develop logical reasoning abilities. Logical reasoning skills and especially the meaningful use of the language of logic (if-then, and, or, not, all, some) are valuable across all areas of mathematics. An understanding of classification, or the recognition of the various attributes of items, is also an essential skill to patterning (extending, exploring, and creating patterns or sequences). These classification skills can be taught through a variety of materials; attribute blocks will be the manipulative used for this session.

The following description of attribute materials is taken from John Van de Walle's *Elementary and Middle School Mathematics: Teaching Developmentally*, 1997.

Attribute Materials:

Attribute materials are sets of objects that lend themselves to being sorted and classified in different ways. Natural or *unstructured* attribute materials include such things as seashells, leaves, the children themselves, or the set of the children's shoes. The *attributes* are the ways that the materials can be sorted. For example, hair color, height, and gender are attributes of children. Each attribute has a number of different *values*: for example, blond, brown, or red (for the attribute of hair color), tall or short (for height), male or female (for gender).

A *structured* set of attribute blocks has exactly one piece for every possible combination of values for each attribute. For example, several commercial sets of plastic attribute blocks have four attributes: color (red, yellow, blue), shape (circle, triangle, rectangle, square, hexagon), size (big, little), and thickness (thick, thin). In the set just described there is exactly one large, red, thin triangle, just as there is one each of all other combinations. The specific values, number of values, or number of attributes that a set may have is not important.

The value of using structured attribute blocks (instead of unstructured materials) is that the attributes and values are very clearly identified and easily articulated to students. There is no confusion or argument concerning what values a particular piece possesses. In this way we



can focus our attention on the reasoning skills that the materials and activities are meant to serve. Even though a nice set of attribute blocks may contain geometric figures of different colors and sizes, they are not very good materials for teaching shape, color, or size. A set of attribute shapes does not provide enough variability in any of the shapes to help students develop anything but very limited geometric ideas. In fact, simple shapes, primary colors, and two sizes are usually chosen because they are most easily discriminated and identified by even the youngest of students (page 393).

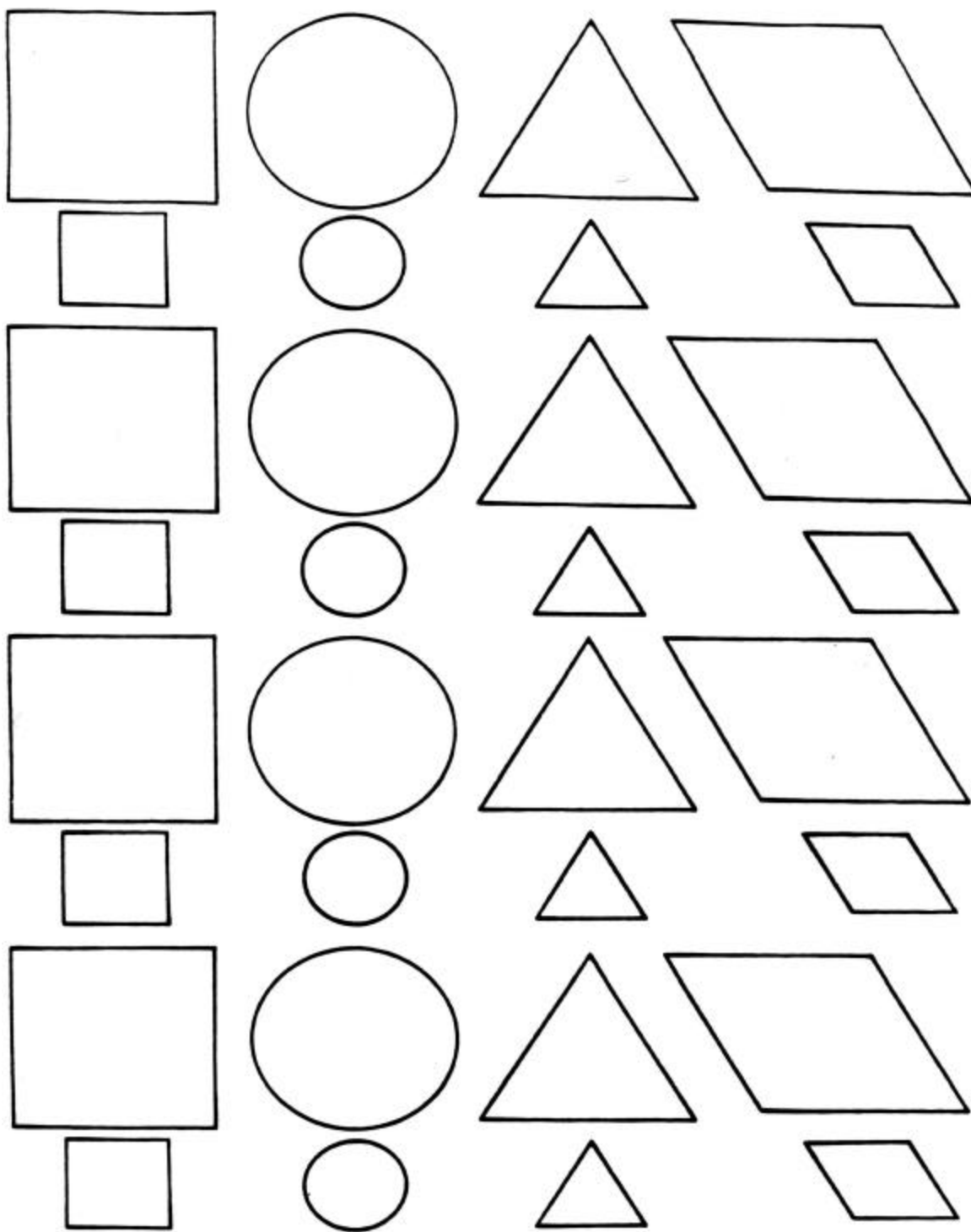
Related SOL: K.11, K.12, K.13, K.17, K.18, 1.16, 1.20, 1.21, 2.25, 3.18, 3.24, 4.21, 5.20

Note:

On the following page you will find an Activity Sheet of the **32-Piece Attribute Blocks**. Copy the page on red, blue, green and yellow cover stock or construction paper and laminate the pages, if possible. Finally, cut out the shapes and place them in baggies before using them for instruction.



Attribute Blocks





Activity: Tibble

Format: Large Group

Objectives: Participants will use logical reasoning to identify specific attributes used to sort them into groups.

Related SOL: 1.20

Materials: None

Time Required: Approximately 5 minutes

Directions:

- 1) Select an attribute, such as the color of a participant's shirt, hair, or some other attribute. Do not tell the participants what has been selected. Call a participant's name and have him/her stand up and say, "You are a Tibble" if the participant has on the color of the shirt you're thinking of (or other attribute); otherwise, say "You are not a Tibble". Continue choosing participants that are Tibbles and not Tibbles. Have participants try to guess what makes a participant a Tibble or not a Tibble
- 2) Let participants take the lead and select a characteristic and determine who is and who is not a Tibble.
- 3) As the participants become more proficient in figuring out the selected attributes, involve two or more attributes in the determination of Tibbles.



Activity: What's In the Box?

Format: Large Group

Objectives: Participants will use logical reasoning to determine the number of pieces in the whole set of attribute blocks after asking questions and receiving information about a few items in the set.

Related SOL: K.11, K.12, K.13, K.17, 1.20

Materials: A standard 32 or 60 piece set of attribute blocks. Using a subset of attribute blocks such as all large or all thick can modify the level of difficulty of the activity. Before beginning this activity, check your set to be sure that it is complete.

Time Required: Approximately 15 minutes

Directions:

- 1) Tell participants, "This box (or bag) contains some materials." Shake it so the participants can hear. "I'd like you to ask me some questions with yes or no answers to figure out what is in the box." If the answer to the question is yes (i.e., Do you have something red in the box?), the trainer pulls out a block that has this attribute and will help the participants determine the number of items in the entire set (i.e., produce a red circle, then maybe a red triangle, to show there are other attributes besides color, etc.).
- 2) During the questions, ask:
 - How many pieces do you think I have left in the box?
 - How many pieces would the total set of attribute blocks contain? Why?
 - What are the characteristics (attributes) of this set of attribute blocks?
 - Is it possible to find a pair of attribute blocks that have neither size, color, thickness, nor shape in common?
 - Is each of the attribute blocks in your complete set unique?
 - How can you determine the number of pieces in the set of attribute blocks? (Answer: Multiply the number of each attribute.)



Activity: Missing Pieces

Format: Small Group

Objectives: Participants will visualize the whole set and divide it into a number of subsets based on the attributes in the set.

Related SOL: K.17, 1.20

Materials: Use standard 32 or 60 piece sets of attribute blocks. Using a subset of attribute blocks such as all large or all thick can modify the level of difficulty of the activity. Before beginning this activity, check your sets to be sure that they are complete.

Time Required: Approximately 15 minutes

Directions:

- 1) Divide the participants into small groups. Tell the participants to spread the attribute blocks on the table or desk. One participant removes a piece while the other participants look away. They are then asked to identify the missing piece without touching any of the pieces on the table. When the missing piece has been identified, the identifier removes the next piece, exchanging roles with the first participant. The activity is repeated.
- 2) After a few rounds of the activity, ask participants to describe the strategies used to organize the pieces.



Activity: What's My Rule?

Format: Small Group

Objectives: Participants will focus on more than one attribute at a time and use logical reasoning to determine how the set of attribute blocks were sorted.

Related SOL: K.17, 1.20

Materials: Use standard 32 or 60 piece sets of attribute blocks. Using a subset of attribute blocks such as all large or all thick can modify the level of difficulty of the activity. Before beginning this activity, check your sets to be sure that they are complete. What's My Rule? Activity Sheet

Time Required: Approximately 15 minutes

Directions: Divide the participants into small groups and have them spread the attribute blocks out. Distribute the What's My Rule? Activity Sheet and review the rules of the game. One participant, the sorter, thinks of a "secret rule" to classify the set of attribute blocks into two groups. The participant tells the rule to the trainer or writes it on a piece of paper without letting the other participants see it. The sorter uses that rule to slowly sort the pieces as the other participants observe. At any time, a player can call "stop" and guess the rule. The correct identification is worth five points. A correct answer, but not the written one, is worth one point. Each incorrect guess results in a two-point penalty. After the correct rule identification, the player who figured out the rule becomes the sorter. The winner is the first one to accumulate ten points.



WHAT'S MY RULE?

Rules

- 1. Choose one player to be the sorter. The sorter writes down a "secret rule" to classify the set of attribute blocks into two or more groups and uses that rule to slowly sort the pieces as the other players observe.**
- 2. At any time, the players can call "stop" and guess the rule. The correct identification is worth five points. A correct answer, but not the written one, is worth one point. Each incorrect guess results in a two-point penalty.**
- 3. After the correct rule identification, the player who figured out the rule becomes the sorter.**
- 4. The winner is the first one to accumulate ten points.**



Activity: Twenty Questions Game

Format: Small Group

Objectives: Participants play a game to develop skill at the strategy of elimination to reduce the set the quickest way in order to identify a specific element.

Related SOL: K.17, 1.20

Materials: Use a standard 32 or 60 piece set of attribute blocks. Using a subset of attribute blocks such as all large or all thick can modify the level of difficulty of the activity. Before beginning this activity, check your set to be sure that it is complete.

Time Required: Approximately 15 minutes

Directions:

- 1) This is a variation of the standard "Twenty Questions" game. Ask one participant to think of a block. The participant tells its name to the teacher or writes its name on a piece of paper without letting the other participants see it. The other participants, in turn, ask yes/no questions about the mystery block. After each question is answered, the participants move to one side those blocks that do not fit the clues already disclosed.

A scorekeeper can count the number of questions asked. Participants try to find the mystery block using the fewest questions possible.

- 2) After a few games ask, "What is the best first question to eliminate the greatest number of blocks?" The participants may suggest, "Is the block four-sided?" This may not be the best first question, especially when the answer is no. Help the participants recognize that a strategy of eliminating the set by half is the quickest way to reduce the set and identify a specific element. In this game, if they are using the 32 piece set (Size: large or small; Color: red, yellow, green, or blue; Shape: square, rhombus, triangle, or circle), participants should learn to reduce the set by half each time as this strategy always provides the answer within five guesses (i.e., $32 = 2^5$). If they are using the 60-piece set (Size: large or small; Thickness: thick or thin; Color: red, yellow, or blue; Shape: square, rhombus, triangle, rectangle, or circle), the answer can be found within 7 guesses.



Activity: Who Am I? Game

Format: Small/Large Group

Objectives: Participants reinforce their understanding of attributes through a game where they use clues to identify a specific attribute piece.

Related SOL: K.17, 1.20

Materials: Use a standard 32 or 60 piece set of attribute blocks. Using a subset of attribute blocks such as all large or all thick can modify the level of difficulty of the activity. Before beginning this activity, check your set to be sure that it is complete. Clue Cards Activity Sheets (32-piece set – sheets 1-3) (60-piece set – sheets 4-6)

Time Required: Approximately 15 minutes

Directions:

- 1) This game can be played by individuals or teams. In the classroom with younger students, the teacher reads the clues. "Clue cards" should be prepared for participants. The players are shown a "clue card." The first player to discover the mystery piece is the winner.
- 2) Participants should be encouraged to develop their own problems to share with others. They may be used as an assessment.



Answers:

32 piece Attribute Set

- 1) Large, red rhombus
- 2) Small, red circle
- 3) Large, green rhombus
- 4) Small, green circle
- 5) Large, red triangle

60 piece Attribute Set

- 1) Large, thick, red rectangle
- 2) Small, thin, red circle
- 3) Large, thin, blue rectangle
- 4) Small, thin, yellow circle
- 5) Large, thin, red triangle
- 6) Large, thick, yellow rhombus



Clue Cards
(32 Piece Attribute Set)

(1)

I am large.

I am not yellow.

I have four sides.

I am not blue and not green.

I am not a square.

Who am I?

(2)

I am not large.

I am green or red.

I am not four sided.

I have no corners.

I am not green.

Who am I?



Clue Cards
(32 Piece Attribute Set)

(3)

I do not fit in a round hole.

I have four corners.

I am not red.

I am large.

I am green.

I am not square.

Who am I?

(4)

I am lost, help me find myself.

When you find me, hold me in your hand.

I am small.

I am not blue.

I am not square.

I am green.

I will roll off the table.

Who am I?



Clue Cards
(32 Piece Attribute Set)

(5)

I am blue or large or square.

I am not green.

I am small or a triangle.

I am red or blue.

I am not a circle.

I am blue or large.

I am not blue.

Who am I?

(6)

Write Your Own!

Who am I?



Clue Cards
(60 Piece Attribute Set)

(1)

I am large and not a square.

I am not yellow.

I have four sides.

I am not blue or thin.

I am not a rhombus.

Who am I?

(2)

I am not large.

I am yellow or red.

I am not four sided.

I have no corners.

I am not yellow or thick.

Who am I?



Clue Cards
(60 Piece Attribute Set)

(3)

I do not fit in a round hole.

I have four corners.

I am not red.

I am large.

I am green.

I am blue and thin.

I am not square.

I am not a rhombus.

Who am I?

(4)

I am lost, help me find myself.

When you find me, hold me in your hand.

I am small. I am not blue.

I am not square or thick.

I am yellow.

I will roll off the table.

Who am I?



Clue Cards
(60 Piece Attribute Set)

(5)

I am blue or thin or square.
I am not yellow.
I am small or a triangle.
I am red or blue.
I am not a circle.
I am blue or large.
I am not blue.
Who am I?

(6)

I am not small or not blue.
I am thick or a triangle.
I am a square or a rhombus.
I am yellow or small.
I am not red or large.
I am not a square.
I am large or not a rhombus.
Who am I?



Activity: Differences - Trains and Games

Format: Small Group

Objectives: Participants will identify the number of differences between two objects (i.e., one difference, two-differences, three-differences, etc.) as they create difference trains and play games where they must identify the number of differences.

Related SOL: K.17, 1.20

Materials: Attribute blocks, Differences Game Mat

Time Required: Approximately 30 minutes

- Directions:**
- 1) Ask participants to compare blocks in terms of their differences and similarities. Hold up a block and ask the participants to hold up a block that differs in one way. Repeat this with several blocks, and then ask them to hold up a block that differs in two ways, then in three ways. At the same time, ask the participants to hold up blocks that are similar in two, one, or no ways.
 - 2) Tell the participants that "Difference Trains" have engines and cars. Place the large, red circle on the table as the engine of the train. Cars are to be sequentially attached to the train according to the given rule. Start with the rule that the car to be attached must differ from the preceding car by a single attribute - by one difference. That is, if the engine is a large, red circle, then there are a variety of possibilities that could be attached as the cars; for example, a small, red circle or a large, yellow circle. Have participants identify all of the possibilities. Ask the participants "Why could the small, blue square not be the first car attached to the large, red circle engine?" Taking turns with their partners, have the participants build a train at least 20 cars long, verbalizing the difference as the next car is put into place.
 - 3) Ask the participants "Could you have built a train using all of the attribute blocks? Try it?"
 - 4) Two-Difference Variation: Have the participants start with the same engine. This time attach a car that differs from the car to which it is attached by two-differences. Ask the participants "Could you have built a train using the 30 large pieces before using any small pieces? Try it!"



- 5) Three-Difference Variation: Have the participants agree on the attribute block to be the engine. Build a train so that the adjacent cars will differ by exactly three differences.
- 6) Differences is a game for two players or two teams on a four-by-four game mat. The blocks are randomly divided equally between the two players or teams. A turn consists of placing a block on the game mat. THE ONLY RULE is that a block must differ from its horizontal and vertical neighbors in exactly one way. The first player who cannot place a block loses. Extension: a block must differ from its neighbors horizontally, vertically, and diagonally. In Game Two, the block must differ in two ways.



Difference Game Mat

Games: Blocks must differ from their horizontal and vertical neighbors in:

- exactly one way (Game 1)
- exactly two ways (Game 2)



Activity: Hidden Number Patterns

Format: Small Group

Objectives: Participants will identify the number of differences between two objects (i.e., one difference, two-differences, three-differences, etc.) as they examine trains of attribute blocks on Hidden Number Sheets..

Related SOL: K.17, 1.20

Materials: Hidden Number Sheets 1 and 2.

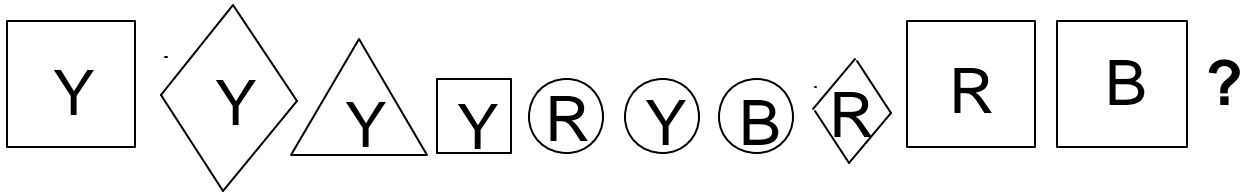
Time Required: Approximately 10 minutes

Directions:

- 1) Have the participants identify the number of differences between two objects (i.e., one difference, two-differences, three-differences, etc.) in the Hidden Number Sheets 1 and 2.
- 2) Have participants create difference trains where they develop a number pattern for the number of differences in their trains.



Hidden Number Sheet #1

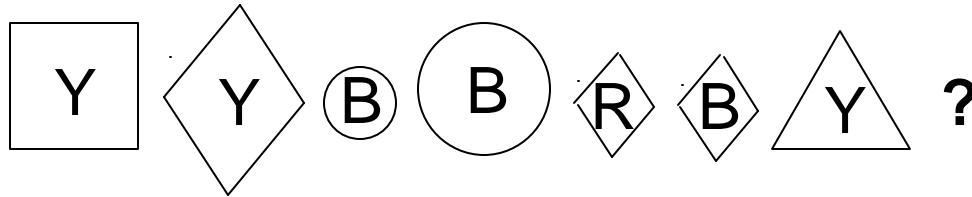


What is the number pattern (of differences) associated with this train?

How many different blocks could be placed after the large blue square?



Hidden Number Sheet #2



What large block would you place after the large yellow triangle?

Why did you select that block?

Are there any other blocks that could immediately follow the large yellow triangle?

What number pattern (of differences) did you discover in the train?



Activity: Attribute Networks

Format: Small Group/Individual

Objectives: Participants complete an attribute network problem to demonstrate their understanding of differences. This may be used as an assessment of the participants' understanding of one-, two-, and three-differences.

Related SOL: K.17, 1.20

Materials: Attribute Network Puzzle Activity Sheet

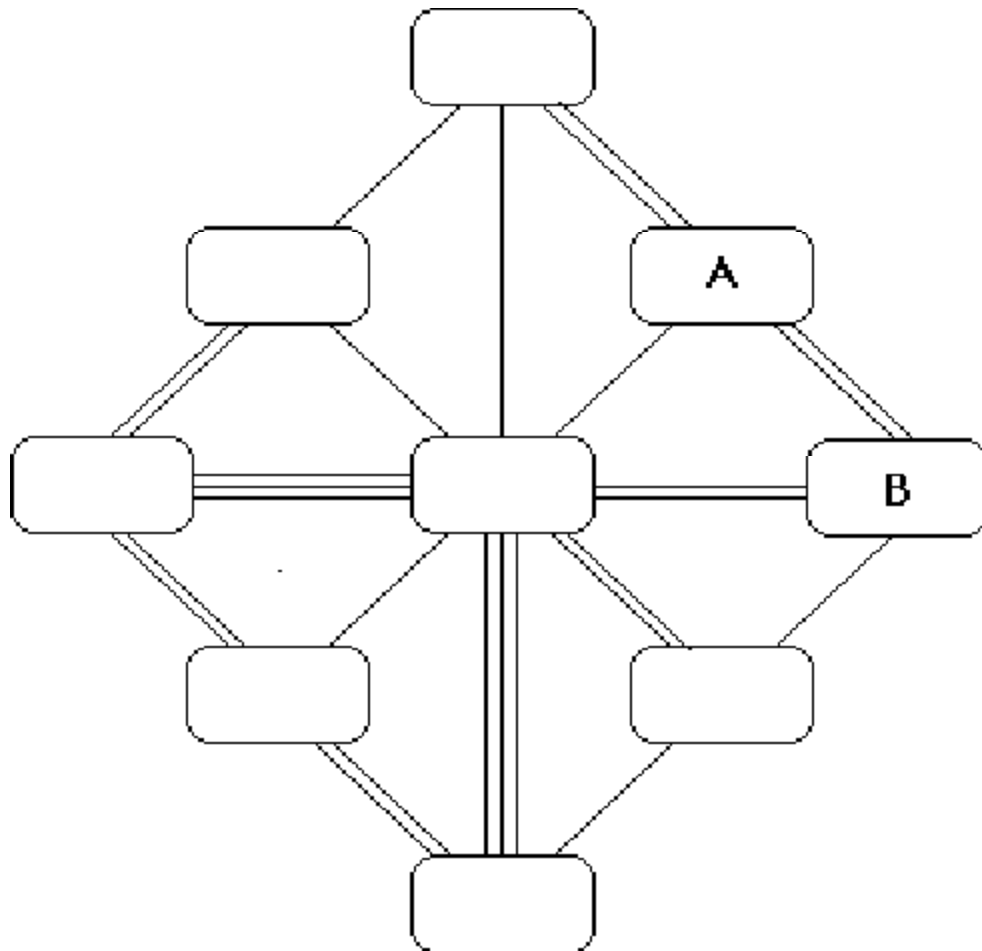
Time Required: Approximately 20 minutes

Directions:

- 1) Distribute Activity Sheets. Place an attribute block on one of the regions. Place another attribute block in an adjacent region that differs from the first piece by as many variables (i.e., color, shape, size, thickness) as there are lines connecting the regions. For example the piece in Region B must differ from the piece in Region A by exactly two attributes.
- 2) Once you have created a solution that works, write your answers in each block.



Attribute Network Puzzle





Topic: Identifying Figures

Description: Participants will explore figures by creating a human circle, creating figures on geoboards, and conducting a figure hunt.

Related SOL: K.11, K.12, 1.16, 1.17, 2.20, 2.22, 3.18, 4.17, 4.17



Activity : Human Circle

Format: Large Group

Objective: Participants will develop a definition of a circle and a sphere after creating a human circle.

Related SOL: K.11, K.12, 1.16, 1.17, 2.20, 2.22, 3.18, 4.17

Materials: Enough pieces of string, each the same length (5-10 feet, depending on the space available), for each participant but one; chalk (optional)

Time required: Approximately 15 minutes

Directions:

- 1) Clear a space larger than twice the length of the cut string or go outside to the playground.
- 2) Choose one participant to be the center.
- 3) Have this center person hold the ends of all the strings in one hand, making a fist with all the strings coming out of the top. This person should crouch down, with his/her arm held over his/her head.
- 4) Have every other person take an end of the string and back up so the string is taut, spacing themselves around the center person in all directions.
- 5) (Optional) Draw a circle with chalk on the ground or floor to approximate the circle created by the humans.
- 6) Discuss the circle as the set of all points in a plane that are the same distance from the center.
- 7) Extend the idea to the set of all points in space that are the same distance from a center point. Contrast a circle and a sphere.



Activity : Geoboard Triangles and Quadrilaterals

Format: Large Group

Objective: Participants will identify various polygons by their number of sides and angles, regardless of their orientation or size.

Related SOL: K.11, K.12, 1.16, 1.17, 2.20, 2.22, 3.18

Materials: Geoboards, rubber bands, geoboard dot paper

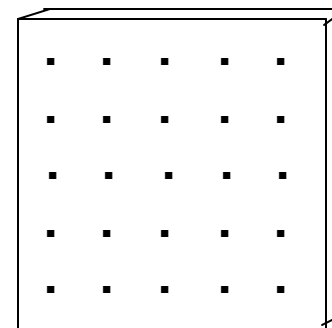
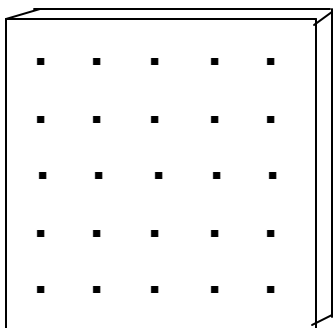
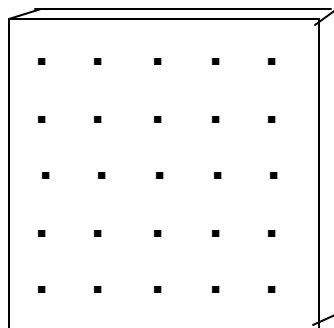
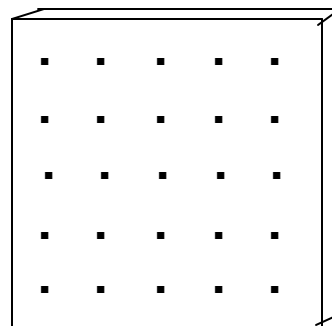
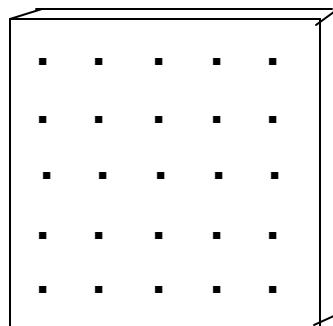
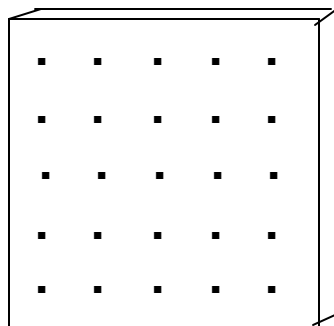
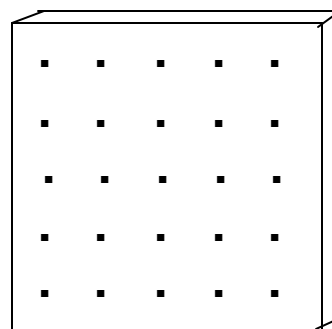
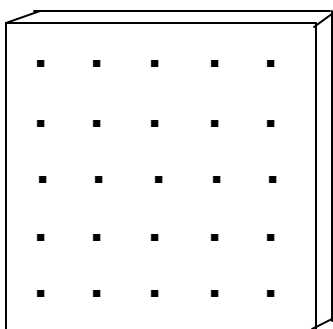
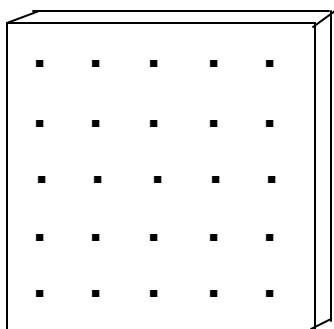
Time required: Approximately 15 minutes

Directions:

- 1) Distribute geoboards, several rubber bands, and a sheet of geoboard dot paper to record their results to participants.
- 2) Ask the participants to make a three-sided figure on their geoboard and to record it on their dot paper.
- 3) Display the geoboards on the chalkboard ledge. Have the participants sort them in various ways (e.g., those having a square corner, those having two equal sides).
- 4) If none of the triangles made are isosceles right triangles, challenge the participants to make a three-sided figure with a square corner and two sides equal in length. Can more than one be made? How are they alike? How are they different?
- 5) Ask the participants to make a figure that has four sides and four square corners and to record it on their dot paper.
- 6) Have the participants make as many **different** figures as they can that have four sides and four square corners. Have them copy these figures onto their dot paper. Discuss how these figures are alike and how they are different.
- 7) Have the participants change the figure on their geoboard from a four-sided figure with square corners to a four-sided figure without any square corners. Copy it onto dot paper and compare to the four-sided figures with square corners. Have the participants describe what they have made.



Geoboard Dot Paper





Activity: Figure Hunt

Format: Small Group/Large Group

Objective: Participants will identify various objects in their environment that depict triangles, rectangles, squares, and circles.

Related SOL: 1.17

Materials: Electronic camera, computer, and drawing software or Polaroid cameras and film, magic markers, poster board, paste

Time required: Approximately 30 minutes

Directions:

- 1) Instruct the participants in the use of the camera.
- 2) Organize the participants into groups of two or three. Assign each group a figure, such as, triangle, rectangle, square, or circle.
- 3) Each group should identify and photograph various objects they find within a specified area that depict their assigned shape.
- 4) If an electronic camera was used, download the images and print them.
- 5) Have the participants outline their figures with the magic marker and create a poster or mural by gluing the figures to the poster board and labeling them.
- 6) Display and discuss the results.